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Operative Vaginal Delivery

The incidence of operative vaginal delivery in the United States is estimated to be 10–15% (1), and although these procedures are safe in appropriate circumstances, controversy about them persists. Recent reports have highlighted the potential for maternal and neonatal complications associated with operative vaginal delivery, although the risks associated with alternative procedures also must be considered. This document will address specific controversial issues about the use of forceps and vacuum extractors for operative vaginal delivery and present the available information on which to base decisions concerning their use. The technical aspects of the use of forceps and vacuum extractors are beyond the scope of this publication.

Background

Clinical studies performed before the 1970s suggested that the risk of fetal morbidity and mortality was higher when the second stage of labor exceeded 2 hours. Currently, more intensive intrapartum surveillance provides the ability to identify the fetus that may not be tolerating labor well. Thus, the length of the second stage of labor is not in itself an absolute or even strong indication for operative termination of labor. When other obstetric factors prevail, however, there is a place for forceps or vacuum-assisted operations.

Operative vaginal deliveries are accomplished by applying direct traction on the fetal skull with forceps, or by applying traction to the fetal scalp by means of a vacuum extractor. The indications for operative vaginal delivery performed with either the vacuum extractor or forceps are the same (see the box, “Indications for Operative Vaginal Delivery”).

The rate of cesarean deliveries in the United States has declined from 22.8% in 1987 to 20.8% in 1997 (2). During the same period, the percentage of births delivered by forceps or vacuum extraction increased slightly, from 9.0% to 9.4% (2). Of this number, the percentage of forceps deliveries has decreased

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Indications for Operative Vaginal Delivery

No indication for operative vaginal delivery is absolute. The following indications apply when the fetal head is engaged and the cervix is fully dilated.

- Prolonged second stage:
 - Nulliparous women: lack of continuing progress for 3 hours with regional anesthesia, or 2 hours without regional anesthesia
 - Multiparous women: lack of continuing progress for 2 hours with regional anesthesia, or 1 hour without regional anesthesia
- Suspicion of immediate or potential fetal compromise.
- Shortening of the second stage for maternal benefit.

and the percentage of vacuum extraction deliveries has increased. Although some authors have suggested that operative vaginal deliveries have been replaced by cesarean deliveries, the relationship remains unclear. Geographic differences in operative delivery rates have been reported, with the lowest rate in the northeast United States and the highest rate in the South.

In 1988, ACOG redefined the classification of station and types of forceps deliveries. The revised classification uses the level of the leading bony point of the fetal head in centimeters at or below the level of the maternal ischial spines to define station (0–5 cm), instead of the previously used method of describing the birth canal in terms of thirds (0–3+).

The definitions of types of forceps deliveries also were refined to avoid the inclusion of either trivial or extremely difficult deliveries under the category of midforceps (see the box, “Criteria for Types of Forceps Deliveries”). Before this reclassification, a rotational delivery from occiput posterior at 0 station was classified the same as a delivery from left occiput anterior on the perineum. In a validation of ACOG’s reclassification, investigators demonstrated that the lower the fetal head and the less rotation required, the less the risk of injury to the mother and the child (3). Assessment of clinical pelvimetry and fetal position is important in predelivery evaluation (see the box, “Predelivery Considerations”).

Clinical Issues

Complications of Operative Vaginal Delivery

General statements about the applicability of operative vaginal delivery and the procedures for implementation in

a particular situation are difficult. Selection of the appropriate instrument and decisions about the potential maternal and fetal consequences should be based on clinical findings at the time of delivery. Research into the complications of operative vaginal delivery is hampered by a number of potential biases, including the level of experience of the operators, the small numbers of patients studied under similar circumstances, changes in practice and definition, and the inability to achieve statistical power to answer relevant questions. The following discussion is based on currently available evidence and attempts to address maternal and fetal complications associated with operative vaginal delivery.

In a randomized trial comparing elective low-forceps delivery with spontaneous vaginal delivery in 50 term patients, there were no significant immediate differences in maternal or neonatal outcome variables. The researchers did show that in the forceps group, the mean time to delivery was shorter (10.2 minutes versus 18 minutes) and the cord arterial pH was higher (7.27 versus 7.23) (4). However, a larger randomized study comparing outlet forceps delivery with spontaneous vaginal delivery in 333 women at term showed that, although the use of forceps had no immediate adverse effects on the neonate, there was no significant shortening of the second stage of labor. However, the incidence of maternal perineal trauma increased in primiparous women (5).

Criteria for Types of Forceps Deliveries

Outlet forceps

1. Scalp is visible at the introitus without separating labia.
2. Fetal skull has reached pelvic floor.
3. Sagittal suture is in anteroposterior diameter or right or left occiput anterior or posterior position.
4. Fetal head is at or on perineum.
5. Rotation does not exceed 45°.

Low forceps

- Leading point of fetal skull is at station $\geq +2$ cm and not on the pelvic floor.
- Rotation is 45° or less (left or right occiput anterior to occiput anterior, or left or right occiput posterior to occiput posterior).
- Rotation is greater than 45°.

Midforceps

- Station is above +2 cm but head is engaged.

High forceps

- Not included in classification.

Predelivery Considerations

Position: the relationship of the fetal presenting part to the maternal pelvis. In a cephalic presentation the designated point is the occiput, while in a breech presentation it is the sacrum. The position always is described in relation to the maternal left and right sides of the pelvis.

Presentation: the relationship between the leading fetal part and the maternal pelvic inlet. The fetus may have a cephalic, breech, or shoulder presentation.

Lie: the relationship between the fetal and maternal longitudinal axes, which may be longitudinal, oblique, or transverse.

Engagement: the relationship that is present when the widest diameter of the fetal presenting part (biparietal diameter in a cephalic presentation, and bitrochanteric diameter in a breech presentation) has passed beyond the plane of the maternal pelvic brim. In a cephalic presentation the head usually is engaged when the leading point of the skull is at or below the maternal ischial spines.

Asynclitism: the relationship between the anterior and posterior parietal bones and the sagittal suture with the maternal pelvis. When neither of the parietal bones precedes the sagittal suture, the head is synclitic; if the anterior parietal bone precedes the sagittal suture, there is anterior asynclitism; and when the posterior parietal bone precedes the sagittal suture, there is posterior asynclitism.

Clinical Pelvimetry: assessment of the maternal pelvis before performing midpelvic delivery.

A meta-analysis comparing vacuum extraction to forceps delivery showed that vacuum extraction was associated with significantly less maternal trauma and less need for general and regional anesthesia. Overall, fewer cesarean deliveries were carried out in the vacuum extractor group (6). Other studies comparing vacuum extraction to forceps delivery indicate that more maternal morbidity (soft tissue injury, discomfort) occurs with forceps delivery (7, 8).

Both forceps delivery and vacuum extraction have been associated with the development of maternal hematomas, (9) and possibly linked to pelvic floor injury. However, other factors associated with pelvic floor injury include normal spontaneous vaginal delivery, episiotomy, prolonged second stage of labor, and increased fetal size (10).

To evaluate the risk of operative vaginal delivery with suspected fetal macrosomia, one study compared 2,924 macrosomic infants (birth weight >4,000 g) to those with a birth weight between 3,000 g and 3,999 g. Macrosomic

infants delivered by forceps had a sixfold higher rate of significant injury (relative risk = 6.7; confidence interval, 6.5–6.9). Forceps delivery in this situation also was associated with a fourfold risk of clinically persistent neurologic abnormalities when compared with spontaneous vaginal delivery or cesarean delivery. The overall incidence of persistent injury was low (0.3%), and the authors calculated that as many as 258 elective cesarean deliveries would have to be performed for macrosomia to prevent a single case of persistent injury (11). In addition, a randomized study of forceps and vacuum-assisted vaginal delivery identified three factors associated with the development of shoulder dystocia: use of vacuum device ($P = 0.04$), time required for delivery ($P = 0.03$), and birth weight ($P = 0.0001$) (12). Therefore, a trial of labor and judicious use of operative vaginal delivery techniques for macrosomic infants are not contraindicated, although caution should be used given the possibility of shoulder dystocia.

Potential Newborn Complications of Vacuum-Assisted Deliveries

With forceps, almost unlimited compression and traction can be applied to the fetal head and cervical spine. Vacuum extractors are designed to limit the amount of traction on the fetal skull because detachment can occur. Nevertheless, traction achieved with vacuum extraction is substantial (up to 50 lb) (13) and can result in significant fetal injury if misused. The vacuum cup can cause scalp lacerations if torsion is excessive. In addition, separation of the scalp from the underlying structures can lead to cephalohematoma, which is more common in infants delivered by vacuum extractor (14–16%) than in those delivered with forceps (2%) (6, 7). The incidence of subgaleal hematomas (collections of blood occurring in the potential space between the cranial periosteum and the epicranial aponeurosis) following vacuum deliveries is estimated to range from 26 to 45 per 1,000 vacuum deliveries (14, 15).

Other potential neonatal complications associated with vacuum deliveries include intracranial hemorrhage, hyperbilirubinemia, and retinal hemorrhage. The higher rates of neonatal jaundice associated with vacuum delivery may be related to the higher rate of cephalohematoma (16). There is a higher rate of retinal hemorrhages (38%) with vacuum delivery than with forceps delivery (17%) (6, 7, 17, 18). However, corneal abrasions and external ocular trauma are more common with forceps delivery than with normal spontaneous delivery and are rare with vacuum extraction unless the cup is inadvertently placed over the eye. Long-term sequelae are extremely rare, and ophthalmologic screening should be reserved for specific cases (18). Overall, the incidence of serious complica-

tions with vacuum extraction is approximately 5% (19). Given the maternal and neonatal risks associated with operative vaginal delivery, it is important that the patient be made aware of the potential complications of the proposed procedure.

In 1998, the U.S. Food and Drug Administration (FDA) released a Public Health Advisory to alert individuals that vacuum extractors may cause serious or fatal complications, including subgaleal (subaponeurotic) hematoma and intracranial hemorrhage (20). The FDA indicated that between 1994 and 1998, 12 deaths and nine serious injuries were reported among neonates on whom vacuum-assisted devices had been used. This rate was greater than five times the rate for the preceding 11 years. According to the advisory, data collected from 1989 to 1995 showed that use of the vacuum cup had increased from 3.5% to 5.9% of all deliveries. Among the FDA recommendations for use of the vacuum device, two are particularly useful:

1. Rocking movements or torque should not be applied to the device; only steady traction in the line of the birth canal should be used.
2. Clinicians caring for the neonate should be alerted that a vacuum device has been used so that they can adequately monitor the neonate for the signs and symptoms of device-related injuries.

A recent study evaluating the incidence of severe birth trauma following operative deliveries assessed the outcome of 83,340 singleton infants born to nulliparous women between 1992 and 1994 in California (21). A database was created linking birth and death certificates with hospital discharge records of maternal and neonatal outcomes. The lowest risk of fetal injury was found in infants delivered spontaneously. An intermediate risk was observed for those infants delivered by forceps or vacuum alone or by cesarean delivery during labor. The highest risk of fetal injury was reported for those infants who were delivered with combined forceps and vacuum extraction or who were delivered by cesarean following failed operative vaginal delivery. There was no difference in outcome between vacuum and forceps delivery versus cesarean delivery during labor (Table 1). The morbidity that previously had been thought to be due to operative vaginal delivery actually may have resulted from the process of abnormal labor that led to the need for intervention. The study population was large, but data were collected retrospectively from medical records and hospital discharge reports. Therefore, detailed information on the operative vaginal delivery, frequency of congenital anom-

Table 1. Effect of Delivery on Neonatal Injury

Delivery Method	Death	Intracranial Hemorrhage	Other*
Spontaneous vaginal delivery	1/5,000	1/1,900	1/216
Cesarean delivery during labor	1/1,250	1/952	1/71
Cesarean delivery after vacuum/forceps	N/R	1/333	1/38
Cesarean delivery with no labor	1/1,250	1/2,040	1/105
Vacuum alone	1/3,333	1/860	1/122
Forceps alone	1/2,000	1/664	1/76
Vacuum and forceps	1/1,666	1/280	1/58

Abbreviation: N/R indicates not reported.

*Facial nerve/brachial plexus injury, convulsions, central nervous system depression, mechanical ventilation

Data from Towner D, Castro MA, Eby-Wilkens E, Gilbert WM. Effect of mode of delivery in nulliparous women on neonatal intracranial injury. *N Engl J Med* 1999;341:1709-1714

alies, or number of infants readmitted following the initial discharge was not available. Despite its limitations, this study confirms that injury can occur before operative delivery as a result of abnormal labor forces and that not all neonatal injuries are the result of poor operative technique.

Long-Term Infant Consequences

One randomized comparison of vacuum versus forceps delivery that evaluated children at 9 months of age found no statistically significant differences between the two groups regarding head circumference, weight, head-circumference-to-weight ratio, hearing, or vision (22). The study did note that infants delivered with the vacuum device were more likely to have been readmitted with jaundice than were those delivered with forceps.

In another study, the effects of forceps delivery on cognitive development were examined in a cohort of 3,413 children. No significant differences were seen in the 1,192 children delivered with forceps (114 were midforceps), compared with the 1,499 delivered spontaneously (23). A 10-year matched follow-up evaluation of 295 children delivered by vacuum extractor and 302 control patients who had been delivered spontaneously at the same hospital revealed no differences between the two groups in terms of scholastic performance, speech, ability of self-care, or neurologic abnormality (24).

Clinical Considerations and Recommendations

► *What are contraindications to operative vaginal delivery?*

Under certain circumstances, operative vaginal delivery should be avoided or, at the least, carefully considered in terms of relative maternal and fetal risk. Most authorities consider vacuum extraction inappropriate in pregnancies before 34 weeks of gestation because of the risk of fetal intraventricular hemorrhage. Operative delivery also is contraindicated if a live fetus is known to have a bone demineralization condition (eg, osteogenesis imperfecta), a bleeding disorder (eg, alloimmune thrombocytopenia, hemophilia, or von Willebrand's disease) is present, the fetal head is unengaged, or the position of the fetal head is unknown.

Operative vaginal delivery should be performed only by individuals with privileges for such procedures and in settings in which personnel are readily available to perform a cesarean delivery in the event the operative vaginal delivery is unsuccessful. One study showed that in cases in which the vacuum extractor was used to deliver fetuses with nonreassuring fetal heart rate patterns, blood gas parameters did not differ from those in cases with normal spontaneous deliveries. The authors concluded that the use of vacuum extraction is not contraindicated in cases of nonreassuring fetal heart rate patterns (25).

► *Is there a role for a trial of operative vaginal delivery?*

Few studies address the issue of maternal and neonatal outcome after an unsuccessful attempt at operative delivery. Earlier published reports were small retrospective studies that suggested outcome was no worse after failed operative delivery (26, 27). In a recent report of 102 cases of failed instrument delivery, almost half (43%) of cases where a trial of operative vaginal delivery was attempted resulted in the need for cesarean delivery. Of those where success was expected, only 3% went on to cesarean delivery (28). In addition, the California study previously discussed demonstrated significantly higher incidences of intracranial hemorrhage and other birth trauma following a failed operative vaginal delivery (21). Unless the preoperative assessment is highly suggestive of a successful outcome, trial of operative vaginal delivery is best avoided.

► *Is there a role for the use of alternative instruments after a failed attempt?*

Persistent efforts to obtain a vaginal delivery using different instruments may increase the potential for maternal

and fetal injury and often indicates cephalopelvic disproportion. Although studies are limited, the weight of available evidence appears to be against attempting multiple efforts at operative vaginal delivery with different instruments, unless there is a compelling and justifiable reason (28). The California study reported that the incidence of intracranial hemorrhage was highest in infants delivered by combined vacuum and forceps compared with other reported methods of delivery (21). The incidences of other injuries also were increased with combined methods of operative vaginal delivery.

► *What special equipment and techniques should be considered with the use of a vacuum extractor?*

Vacuum extractors differ substantially from the original metal cup and currently vary by material, cup size and shape, and the method of vacuum application to the fetal scalp (manual or automatic). The proliferation and increased use of these instruments have resulted in the development of a number of different techniques. Randomized trials comparing soft vacuum cups to the original metal cup indicate that the pliable cup is associated with decreased fetal scalp trauma but increased rates of detachment from the fetal head (29–32). However, there are no differences between Apgar scores, cord pH, neurologic outcome, retinal hemorrhage, maternal trauma, and blood loss (32). These findings support those of another study, which found a 22% incidence of significant fetal scalp trauma with the soft cup, as opposed to a 37% incidence with the metal cup. This study also concluded the soft cup was more likely to fail than the metal cup when excessive caput was present (29).

Data show that the use of rapid vacuum application leads to a reduction in time to delivery (33, 34). No differences in detachment from the fetal scalp or in maternal or neonatal morbidity between the two techniques have been noted (33, 34). Specifically, one randomized study of 94 women comparing a one-step rapid application of vacuum with conventional stepwise application of vacuum found a significant reduction in the time from application to delivery (6 minutes) in the rapid application group without any differences in maternal or neonatal morbidity (33).

Cephalohematoma has been shown to be more likely to develop as the duration of vacuum application increases. One study demonstrated that 28% of neonates in whom the application-to-delivery time exceeded 5 minutes developed cephalohematoma (35). A further technical issue that has raised questions is whether the vacuum should be reduced between contractions to prevent fetal scalp injury. A randomized controlled trial involving 322

patients at 34 weeks or more of gestation highlighted factors involved in the development of fetal cephalohematoma from vacuum extraction using the M-cup (a semirigid plastic cup, modeled after the Malmstrom cup). To prevent fetal loss of station, 164 patients had continuous vacuum application (600 mm Hg) during and between contractions as well as during active efforts at delivery. In the comparison group, 158 patients had intermittent suction (reduction of vacuum application to 100 mm Hg between contractions) and no effort to prevent loss of station between contractions. Time to delivery, method failure, maternal lacerations, episiotomy extension, incidence of cephalohematoma, and neonatal outcome were similar between the two groups. Overall, the efficacy of the vacuum cup was 93.5%, and the cephalohematoma rate was 11.5%. The authors concluded that there are no differences in maternal or fetal outcome with intermittent reduction in vacuum or attempts to prevent loss of station. They also concluded that the results obtained with the M-cup are comparable to those reported with the stainless-steel Malmstrom cup (36).

► ***Is there a role for midforceps rotational deliveries in current practice?***

The decrease in experienced teachers and the increase in medical–legal concerns have reduced the number of current practitioners skilled in the art of midcavity rotational delivery. Studies comparing midforceps and cesarean deliveries indicate that midforceps delivery is not associated with worse neonatal outcome (Apgar score, cord blood gas, neonatal intensive care admissions, birth trauma) than is cesarean delivery (37, 38). In addition, outcome appeared no worse for those infants in whom Kielland’s forceps rotation was attempted but was unsuccessful (38). One retrospective analysis compared 358 midforceps deliveries with 486 cesarean deliveries and found maternal morbidity (intraoperative and postoperative complications, blood loss, and length of stay) to be higher in the cesarean delivery group (37). Another study reported similar findings in a 5-year retrospective study involving 253 patients (38).

A retrospective study compared 552 deliveries with Kielland’s forceps rotation, 95 cases using Scanzoni maneuver with a different type of forceps, and 160 cases using manual rotation and forceps. Investigators found no significant differences in maternal or neonatal outcomes between the groups regardless of whether the indication was relative dystocia or nonreassuring fetal status (39). An earlier study found that Kielland’s forceps rotation was associated with a higher incidence of neonatal trauma, although the analysis did not specify the indications for operative delivery (40).

There are no randomized controlled studies of long-term follow-up from which to draw conclusions. However, retrospective case–control analyses seem to indicate no differences in outcome between midforceps delivery and cesarean delivery or vacuum extraction (41, 42). A matched-pairs analysis of patients 2 years after a midforceps delivery compared with a group delivered via cesarean delivery (matched for the immediate indication for operative delivery, birth weight, gestational age, sex, and race) found no difference in abnormal outcomes between the groups (41). An 18-year follow-up study of males delivered by midcavity Kielland’s forceps rotation did not show any late adverse effects when subjects were compared with males delivered by vacuum extractor (42). Thus, there appears to be a role for midforceps rotational deliveries in current practice. However, given the potential complications, this procedure is only for practitioners skilled in midforceps delivery and for cases where maternal and fetal assessment prior to the operation suggest a high chance of success.

Summary

The following recommendations are based on good and consistent scientific evidence (Level A):

- Both forceps and vacuum extractors are acceptable and safe instruments for operative vaginal delivery. Operator experience should determine which instrument should be used in a particular situation.
- The vacuum extractor is associated with an increased incidence of neonatal cephalohematoma, retinal hemorrhages, and jaundice when compared with forceps delivery.

The following recommendations are based on limited or inconsistent scientific evidence (Level B):

- Operators should attempt to minimize the duration of vacuum application, because cephalohematoma is more likely to occur as the interval increases.
- Midforceps operations should be considered an appropriate procedure to teach and to use under the correct circumstances by an adequately trained individual.
- The incidence of intracranial hemorrhage is highest among infants delivered by cesarean following a failed vacuum or forceps delivery. The combination of vacuum and forceps has a similar incidence of intracranial hemorrhage. Therefore, an operative vaginal delivery should not be attempted when the probability of success is very low.

The following recommendations are based primarily on consensus and expert opinion (Level C):

- ▶ Operative vaginal delivery is not contraindicated in cases of suspected macrosomia or prolonged labor; however, caution should be used because the risk of shoulder dystocia increases with these conditions.
- ▶ Neonatal care providers should be made aware of the mode of delivery in order to observe for potential complications associated with operative vaginal delivery.

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The MEDLINE database, the Cochrane Library, and ACOG's own internal resources and documents were used to conduct a literature search to locate relevant articles published between January 1985 and November 1999. The search was restricted to articles published in the English language. Priority was given to articles reporting results of original research, although review articles and commentaries also were consulted. Abstracts of research presented at symposia and scientific conferences were not considered adequate for inclusion in this document. Guidelines published by organizations or institutions such as the National Institutes of Health and the American College of Obstetricians and Gynecologists were reviewed, and additional studies were located by reviewing bibliographies of identified articles. When reliable research was not available, expert opinions from obstetrician-gynecologists were used.

Studies were reviewed and evaluated for quality according to the method outlined by the U.S. Preventive Services Task Force:

- I Evidence obtained from at least one properly designed randomized controlled trial.
- II-1 Evidence obtained from well-designed controlled trials without randomization.
- II-2 Evidence obtained from well-designed cohort or case-control analytic studies, preferably from more than one center or research group.
- II-3 Evidence obtained from multiple time series with or without the intervention. Dramatic results in uncontrolled experiments also could be regarded as this type of evidence.
- III Opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees.

Based on the highest level of evidence found in the data, recommendations are provided and graded according to the following categories:

Level A—Recommendations are based on good and consistent scientific evidence.

Level B—Recommendations are based on limited or inconsistent scientific evidence.

Level C—Recommendations are based primarily on consensus and expert opinion.

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